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EXCHANGE RATE VARIABILITY AND AGRICULTURAL TRADE BETWEEN DEVELOPED COUNTRIES

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ABSTRACT

Using a sample consisting of bilateral trade flows across 10 developed countries between 1985 and 1990, this paper explores the effect of exchange rate variability on the growth of agricultural trade. Controlling for other factors likely to determine the growth in bilateral trade, the results show that exchange rate variability has had a significant negative effect on the growth of agricultural trade over this period. The econometric results are used to simulate the likely growth of trade if exchange rates had been as stable as in the 1960s or as volatile as the 1974-1984 period.

Keywords: exchange rate variability, growth of agricultural trade, developed countries.

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Introduction

There has been considerable dispute among international economists as to whether the high level of exchange rate volatility that has characterised the world economy since the breakdown of the fixed exchange rate system has had a negative effect on international trade. The most common assertion has been that the uncertainty caused by exchange rate variability will consequently reduce the level of exports[1]. However, this is countered by the argument that the use of forward markets could ameliorate the negative effect of uncertainty, particularly in the short - to medium run. There have been a large number of empirical studies that have attempted to shed light on this issue, though the econometric evidence that has considered the impact of exchange rate uncertainty on trade flows is ambiguous[2]. However, in a series of recent papers, De Grauwe (De Grauwe, 1988 and De Grauwe and De Bellefroid, 1986), argue it is not short-run variability that is relevant: rather, it is long-run variability in exchange rates that is likely to affect trade. Furthermore, rather than focussing on levels of trade (which is the dependent variable in most empirical studies), De Grauwe argues that the relevant variable is the *growth* of international trade. With the emphasis on growth of international trade over periods of 5 to 10 years, De Grauwe finds long-run variability of real exchange rates to have negatively affected trade. Consequently, the slowdown in the growth of international trade since the early 1970s is clearly linked to the high levels of exchange rate variability observed over this period.

Agricultural economists have also recognised the potential importance of exchange rate changes on trade in food and agricultural products. Much of this research has focussed on trends in the exchange rate (see, for example, Schuh, 1974, and Chambers and Just, 1979) with only a few studies focussing on exchange rate variability. Reflecting the wider literature, empirical research relating to exchange rate variability on agricultural trade flows has given no unambiguous conclusions. For example, Pick (1990) found that exchange rate risk had no effect on US trade flows to other developed countries, though it did have a negative effect on US exports to developing countries. In general, three important criticisms can be made of the literature relating to exchange rate variability and agricultural trade: first, and most obviously, empirical studies that have addressed this issue have been rather sparse, the two most obvious exceptions being Pick (*ibid.*) and Anderson and Garcia (1989)[3]; second, the emphasis has been on US agricultural trade

flows with (to the best of our knowledge) no studies being available that have considered the effect of exchange rate variability or bilateral trade flows of other countries; third, the focus of attention has been on short-run exchange rate variability on levels of trade while the effect of long-run exchange rate variability on the growth of agricultural trade has been ignored.

This paper, therefore, addresses the issue of *long-run* exchange rate variability on the *growth* of agricultural trade. The data used in this study comprises of bilateral agricultural trade flows over 10 developed countries between 1985-1990. The principal attraction of cross-sectional bilateral trade flow data is that it allows us to consider a range of factors that are likely to determine the growth of trade between countries including income growth, the effects of trading blocs such as the European Community (EC) and the growth in agricultural production due to technological advances and incentives due to agricultural policy. Clearly, the interest lies in whether exchange variability has affected the growth in agricultural trade once we have controlled for these other factors. The paper is organised as follows. In section 1, an overview of the data set and a review of key statistics relating to the growth of agricultural trade and exchange rate variability since the 1960s is presented. In section 2, the econometric specification is discussed while in section 3 the econometric results are reported. In section 4 we consider the likely impact of exchange rate variability on trade in the 1985-1990 period by considering previous experience of exchange rate behaviour. We conclude with comments on further aspects of this research programme in section 5.

1. Exchange Rates and the Growth of Agricultural Trade: 1962-1990

As is well-known to even the most casual observer of economic trends in the post-war period, the world economy has been characterized by high rates of growth in world trade in all sectors over the 1960s, with considerably lower (and more variable) rates of growth in total trade over the 1970s and 1980s. The high levels of growth in world trade were due to (or at least coincided with) high rates of growth of GDP in most developed countries, the reduction in tariffs resulting from various GATT rounds and exchange rate stability under the auspices of the Bretton-Woods system. The 1970s and 1980s told a very different story: the growth in world trade slowed considerably; GDP growth rates fell; protectionism increased; and exchange rates became more volatile following the collapse of the fixed exchange rate regime. Reflecting the patterns of manufacturing trade over the 1960-1990 period, growth in trade of agricultural products was extremely high over the 1960s, but slowed dramatically in the post-1973 period.

Relevant data which highlight these patterns are presented in Table 1. The summary figures reported in this table relate to bilateral trade flows in agricultural and food products between a sample of 10 developed countries over the 1962-1990 period. The 10 countries that comprise the sample are Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Switzerland, the UK and the US. Taken together, these countries account for 57 per cent of total world imports of food and agricultural products, and around 46 per cent of total world exports (1985 shares). The figures in the table highlight the contrast between the 1960s and the post-1973 period for these 10 countries. In the 1962-1969 period, bilateral agricultural trade flows between the sample countries grew at an annual average rate of 11.3 per cent; in the 1974-1984 period, the growth of agricultural trade was, on average, 4.0 per cent. However, in the 1985-1990 period, the annual average rate of growth had fallen further to 2.5 per cent.

In part, the slowdown in agricultural trade in the post-1973 period may reflect the slowdown in GDP growth in these 10 countries. The relevant data are also presented in Table 1: in the 1962-1969 period, the average annual growth rate of real GDP was 5.2 per cent. In the 1974-1984 period, the annual average real GDP growth rate had fallen to 2.0 per cent, though there were signs of recovery in the 1985-1990 period with annual average growth of 3.2 per cent. Since import elasticities tend to be high, one would expect growth rates in GDP to have a significant effect on growth of agricultural trade flows.

Also reported in Table 1 are the annual average growth rates in agricultural production between 1962-1990. It may be argued that the growth in agricultural trade flows reflect domestic production growth due to technological developments and/or incentives due to agricultural policies. The figures show that for these 10 countries, the annual average growth in agricultural production was 1.9 per cent between 1962-1969. This growth rate was almost the same over the 1974-1984 period (2.0 per cent), though it slowed dramatically to 0.7 per cent between 1985-1990.

Table 1 **Annual Average Rates of Growth of Agricultural Trade, GDP, Agricultural Production for Sample Countries: 1962 - 1990**[1]

	1962-1969	1974-1984	1985-1990
Agricultural trade	11.3	4.0	2.5
GDP	5.2	2.0	3.2
Agricultural production	1.9	2.0	0.7

[1] Sample countries detailed in text.

Of course, the focus of this paper is the potential effect of exchange rate variability in affecting these trade flows. Figures 1 and 2 show trends in real exchange rate variability for a sub-sample of countries. Figure 1 refers to the US-Dollar-Yen rate while Figure 2 presents changes in the Deutchmark-French Franc rate. It is evident from these two figures that exchange rates were relatively stable between 1962-1969: however, in the post-1973 period, exchange rates have become more volatile. This is true for all bilateral real exchange rates involving the 10 sample countries. However, for EC countries, relative exchange rate variability has been reduced (though not completely stabilized) due to participation in the European Monetary System. This is evident from Figure 2 while a comparison of estimated variances (not reported) over time confirms the decrease in exchange rate variability between EC countries.

Figure 1

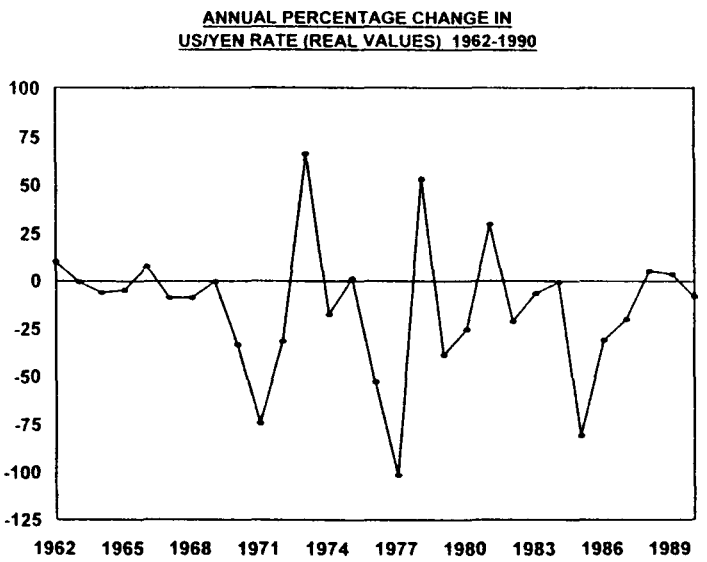
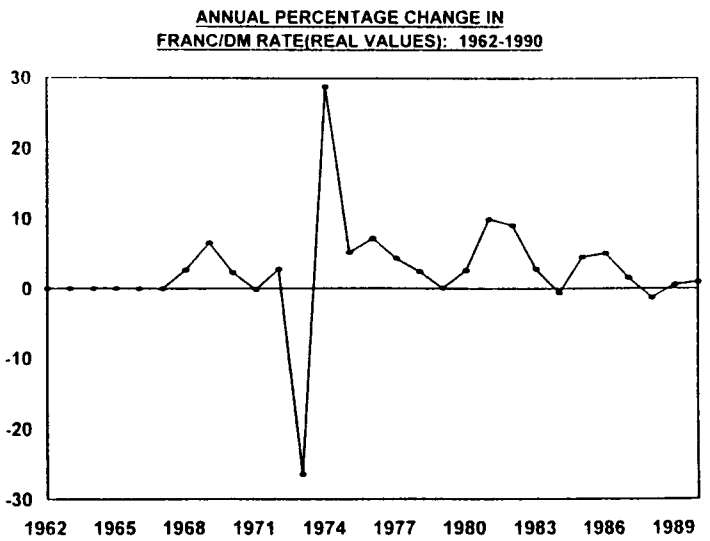


Figure 2



Source: IMF International Financial Statistics (various)

The key question, therefore, that is addressed in this paper is whether the high levels of exchange rate variability have negatively affected the growth of agricultural trade between the 10 sample countries. In order to identify the exchange rate variability effect, however, we need to account for other factors which may have induced the slowdown in agricultural trade flows over the 1985-1990 period.

2. Econometric Specification

The econometric model focuses on the determinants of the growth of bilateral trade in agricultural products. The model is specified as follows[4]:

$$AT_{ijt} = f(GDP_{jt}, ERV_{ijt}, APG_{it}, DEC_{ijt}) \qquad (1)$$

where AT_{ijt} = annual average growth in bilateral trade between exporting country i and importing country j over period t;

GDP_{jt} = annual average growth rate of real GDP in importing country j over period t;

ERV_{ijt} = measure of variability in the real exchange rate between countries i and j over period t;

APG_{it} = annual average growth rate of agricultural production in exporting country i over period t;

DEC_{ijt} = dummy variable for trade between countries which are members of the European Community,.

The model was estimated over the 1985-1990 period. Since we are interested in growth rates of trade and how they are affected over the long-run, all data is converted to annual average growth rates in real terms over the sample period. Although the base data involves 450 observations, this is collapsed to a cross-section of average real growth rates involving 90 observations. Further details on the variables used are given in the appendix. In terms of expected signs, we would expect the coefficient on the GDP growth rate to be positive, the coefficient on agricultural production growth to be positive and the coefficient on the EC variable also to be positive. In determining the exchange rate variability effect, the focus is on whether the coefficient is negative and significant.

3. Results

The model was estimated by ordinary least squares and preliminary analysis suggested that no correction for heteroscedastic disturbances was necessary. The results from estimating (1) are given in Table 2.

Table 2 **Determinants in the Growth of Agricultural Trade over Sample Countries: 1985-1990[1]**

Variable	Coefficient
Constant	-14.492** (-4.041)
Real GDP growth	5.336** (5.323)
Real exchange rate variability	-0.159** (-2.582)
Growth of agricultural production	0.745* (1.987)
EC membership	4.452** (3.404)
$\bar{R}^2 = 0.36$	

[1] t - ratios are in parenthesis.
* - significant at 5 per cent level.
** - significant at 1 per cent level.

The regression performs well with the $\bar{R}^2$ statistic of 36 per cent being very acceptable for cross-section studies of this kind. All variables have the expected sign and all are significant at the 1 per cent level with the exception of the growth rate of agricultural production which was significant at the 5 per cent level. In terms of the specific focus of this paper, the results show that exchange rate variability has had a significant negative effect on the growth of agricultural trade. Measured at the mean, the elasticity of exchange rate variability on the growth of agricultural trade is given as -0.87. One should recall that the negative effect of exchange rate variability on agricultural trade between developed countries reported here conflicts with results of Pick (*op.cit.*) who focused on the effect of short-term exchange rate variability on the level of US exports of agricultural goods to selected developed and developing countries. Pick concluded that exchange rate risk had no effect on US exports to developed countries: however, the results presented above suggest that the growth of agricultural trade between developed countries in the 1985-1990 period has been slower because of exchange rate variability.

In terms of decomposing the contribution the role of each of the factors to the growth of agricultural trade over the 1985-1990 period, exchange rate variability was second in importance only to real GDP growth although the negative effect of real exchange rate variability outweighed the agricultural production growth effect and the EC membership effect taken together[5].

4. Simulations

The measure of real exchange rate variability in the sample period used in this paper falls between that of the 1974-1984 and 1962-1969 periods. In the former period, measured variability of exchange rates between the 10 sample countries was considerably higher than the 1985-1990 period, while in the 1962-1969 period it was (not surprisingly) significantly lower. There are two interesting questions to answer: (i) if real exchange rate variability had remained as high as during the 1974-1984 period, by how much would the growth of agricultural trade slowed further than that observed? and (ii) if exchange rates had been as stable as the 1960s, what would have been the consequent growth in agricultural trade? Though one should recall the Lucas critique, the results are nevertheless illustrative. The results of this experiment are reported in Table 3.

Table 3 Real Exchange Rate Variability and Growth in Agricultural Trade: 1985-1990

	Annual Average Percentage Growth
Recorded growth in agricultural trade	2.5
More variable real exchange rates[1]	1.2
More stable real exchange rates[2]	3.3

[1] The scenario here is to use recorded real exchange rate variability over the 1974-1984 period.
[2] The scenario here is to use recorded real exchange rate variability over the 1962-1969 period.

Not unsurprisingly, if real exchange rates in the 1985-1990 period had been as variable as in the 1974-1984 period, growth in agricultural trade would have slowed to 1.2 per cent annually. However, if real exchange rates had been as stable as those in recorded in the 1960s, agricultural trade would have grown by an additional 0.8 per cent to an average of 3.3 per cent per annum.

Conclusion

The focus of this paper has been to assess whether exchange rate variability has affected the growth in agricultural trade. In order to explore this, we constructed a bilateral trade matrix involving agricultural trade flows between 10 developed countries, collapsed the data to annual average growth rates and estimated the model over the 1985-1990 period. Importantly, we were able to separate out other factors which may influence the growth of agricultural trade over this time frequency. The conclusion is clear: the growth of agricultural trade has been adversely affected by excess variability in real exchange rates. Consequently, reducing real exchange rate variability will likely increase agricultural trade flows significantly. In turn, this re-emphasises the message arising from the literature relating to the effect of macro-economic factors on developments in the agricultural sector. However, the results here show that the macro-economic/agriculture linkage is not restricted to the US and macro-economic disturbances are likely to have long-run effects on trade performance.

The results reported here are part of a larger project dealing with the impact of exchange rate developments on agricultural trade issues. Relevant extensions under consideration include extending the estimating period to 1973-1990, picking out the effects of exchange rate management such as the European Monetary System and extending the sample of countries. The value of these extensions is clear from the present paper in that in order to understand determinants of agricultural trade flows, real exchange rate variability appears to matter and it matters more than suggested by previous studies which have addressed this issue.

Appendix

This appendix details variable definitions and data sources.

The dependent variable X_{ijt} is defined as the average yearly growth rate of exports of country i to country j during period t. The sample of countries includes Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Switzerland, UK and US. Since we are focussing on annual average growth rates, the sample size is (10 x 9) = 90. X_{ijt} is constructed as follows: using the UN bilateral trade data set, we get imports by j from i (import data are more complete than export data). This is then converted into the exporting country's currency using the dollar rate from the

IMF series (International Financial Statistics), and deflated by the export unit value index (1985 = 100) from the IMF series (line 74).

Y_{jt} is the average yearly growth rate of GDP for an importing country j. The GDP data comes from the IMF series (line 99b), which is already deflated to 1985 prices.

S_{ijt} is exchange rate uncertainty measured as follows. First an index E_{ijt} of nominal bilateral exchange rates is calculated based on taking the dollar rate for the importing country j and dividing by the dollar rate for the exporting country i giving the cross-rate, which is then indexed to 1985 =100. The real bilateral exchange rate index R_{ijt} is then calculated, defined as $E_{ijt}\ P_{jt}/P_{it}$, where P_{it} and P_{jt} are wholesale price indices for each country P_{jt}/P_{it} , where P_{it} and P_{jt} are wholesale price indices for each country pairing taken from the IMF series (line 63). Volatility is measured as the standard deviation in this index over 1985-1990.

Finally, the growth rate in agricultural production in country i is measured as the annual average change in the production index as reported in the FAO Production Yearbook.

Notes

[1] Of course, this need not always be true. As shown by Newbery and Stiglitz (1981), uncertainty may increase or decrease effort, the positive or negative effect being dependent on the shape of the utility function. However, the common view is that uncertainty is likely to have a negative effect on effort and utility.

[2] Relevant studies here include Cushman (1988), Gotur (1985), and Kenen and Rodrik (1986) to name a few.

[3] Anderson and Garcia (1989) find significantly negative effects of exchange rate variability on agricultural trade flows to three developed countries. However, their study deals only with US exports of soybeans.

[4] Following De Grauwe and De Bellefroid (1986), we omit relative prices since annual changes in relative prices are unlikely to affect long-run growth rates. Current work by the authors relates to considering the appropriateness of this assumption.

[5] This was done by substituting the mean values for the dependent variables into the estimated equation and calculating the effect on growth rates of agricultural trade.

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